Rates Example
Karst Workgroup - March 17, 2016

Kevin Erb - UWEX

The purpose of these examples is to show the impact of the proposed manure rate limitations. Manure rates should be determined by a number of factors:

1) The ability of the soil to absorb the liquid application being made at the time—i.e. hydraulic loading. Think of this as Table 3 in our discussion. The application can be split over multiple applications. This often doubles the application cost.

2) The ability of the soil to supply nutrients. This is determined by the soil type, organic matter, past history (including crop) and soil depth. Some subsoils are naturally high in Phosphorus (P) or Potassium (K) and some lower. pH also plays a large role in how much of what is in the soil is biologically available.

3) The nutrient content of the manure, organic product, or fertilizer being applied. With non-commercial fertilizers, the nutrients are released over time as the soil biology breaks down the organic materials. For manure/organics, research based on material type, soil temperature and other factors is the basis for the "available" portion of each nutrient. For fertilizers, there is a standard procedure in state law, and these are considered "immediately available"

Table 3 in NR 214 notes maximum weekly application rates based on the soil's ability to absorb the liquid. In most cases, this waste is very, very low solids (<2% I assume), and in the case of a spray field (such as a cheese factory), has already been through some type of solids removal process. Part of the reason for the weekly limit is that, as soon as all of the pores in the soil are full of water, we get more direct flow and less filtering takes place. The rates below are based on low nutrient content, and are designed to allow large volumes over the course of the growing season. A cheese factory, for example, could apply 270,000 gallons/acre over the course of 10 weeks using Table 3, as long as the maximum contaminant loadings are not exceeded.

Ex. 5 Deliberative Process (DP)

there are applied by NRCS Soil Textures

Table 3
Maximum Weekly Volume of Liquid Waste to be Applied to Landspreading Sites (gal/ac/wk or in/wk)

Soil Texture	18"–36" Depth to Groundwater or Bedrock	Greater than 36" Depth to Groundwater or Bedrock
Sand	6,750 (1/4 in.)	13,500 (1/2 in.)
Sandy Loam	13,500 (1/2 in.)	27,000 (1 in.)
Loam	13,500 (1/2 in.)	27,000 (1 in.)
Silt Loam	13,500 (1/2 in.)	27,000 (1 in.)
Clay Loam	13,500 (1/2 in.)	20,000 (3/4 in.)
Clay	6,750 (1/4 in.)	13,500 (1/2 in.)

For manure application, we try to meet the agronomic need with a single pass or application to reduce soil compaction and application expense. The term "agronomic need" assumes that we are looking at what is needed to produce the crop and NOT in a "waste disposal" mode. Here's how that is figured out:

When the recommendation is written, it starts with the soil test lab analysis, which, when combined with the soils information, provides a set of recommendations for major nutrients (N, P K) to be applied. If the naturally occurring levels are very high or excessively high, then little or no P or K are recommended. If they are optimum, the amount removed by the crop is recommended, and if they are low, crop removal plus some additional is recommended to build the soil test to optimum levels. For P and K, we will often apply a "build-up/draw down" strategy where more than one year's needs are applied at one application to reduce trips across the field and allow for incorporation/avoid topdressing in forage crops. Soil tests for nitrogen are done in corn at sidedressing time, however, they are not accurate if any commercial fertilizer has been applied since the last crop harvest.

So if the soil test calls for 120-55-35 for 120 bushels of corn for grain, the farmer has the choice of manure, fertilizer, or a combination of these. Rate is determined by dividing the need (from the soil test) by the amount in each 100# of fertilizer, ton of manure, or 1,000 gallons of manure. Or:

Rate = Need divided by product

Assume we have a manure that has been tested with a concentration of 12-6-17 per thousand gallons. In this case, the nitrogen need from the soil test is 120, so 120 divided by 12 = 10,000 gallons to the acre. That 10,000 gal rate would meet the crop's nitrogen need. It would apply 60 P[1] (10,000 gal * 6# P per 1000 gal = 60# P/acre). Our soil test need for P was 55, so we have applied slightly over the crop need. This will "build" soil test P by ~ 0.3 ppm, and will be lowered later in the crop rotation under a build-up/draw-down philosophy.

If the manure is low nutrients, (say half that amount or 6-3-8 per thousand gallons, the agronomic N rate would be double, or a one time application of 20,000 gallons/acre (20,000 gal * 6 lbs N/1,000 gallons = 120 lbs N).

In the first example, we assumed that the manure was injected or incorporated within one hour to reduce odor and nitrogen losses. For this example let's assume that the manure remains on the surface for 6 hours before incorporation. The N-P-K of each 1,000 gallons would be 10-6-17. If the rate is capped at 10,000 gallons, this application would provide 100 units of nitrogen (10,000 gal * 10 lbs N /1,000 gallons). This would supply 100 of the 120 units of nitrogen needed by the corn crop, meaning that the farmer needs to apply 20 additional units of nitrogen as fertilizer. Their supplier has given them a choice of liquid 28% at 3#/gallon or Urea at 46-0-0, or 46 units of N per 100# of fertilizer. The farmer would apply either:

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[1] Soil Test P and K are expressed in parts per million (or ppm). The fertilizer recommendations, fertilizer concentrations and manure analysis are in the oxide form (p is P2O5, K is K2O)

20 units N divided by 3#/gal = 6.67 gal/acre
OR
20 units N divided by 46#/cwt = 43# Urea/acre

Since dry fertilizer equipment is not set up to accurately apply less than ~125 #/product/acre, the farmer will need to sidedress or apply 6.67 gal 28% per acre. This low rate is difficult but not impossible to achieve. This rate will underapply P, and the need will likely be met with a starter fertilizer application

If the farmer is limited to 6,000 gal/acre, and the N-P-K of each 1,000 gallons of manure is 10-6-17, then the manure rate would provide 60-36-102 (6,000 gal * 10 lbs N /1,000 gallons). The 6,000 gal/acre manure application would provide 60 units of nitrogen and the farmer would need to apply 60 additional units of nitrogen to meet corn crop N need. Using the equations above, that is 20 gallons of 28% (20 times 3#/gal) or 130# of urea/acre (60 divided by 46 per cwt). This 6,000 gal/acre rate will apply 36#P, or 65% of crop need (6,000 gal * 6 lbs P/1,000 gallons). The remaining need will either be applied as fertilizer this year, or during a manure application prior to soybeans when the nitrogen is not needed by the crop.

If the farmer is harvesting the corn for silage, then the P and K recommendations increase significantly based upon corn yield and corresponding P removal by the corn). A 20 ton corn silage yield's recommendation (same soil test as previous example—in the optimum category) would be 120-72-166.